Bailey

SECTION
E12-44

PRODUCT INSTRUCTIONS

SOLID-STATE A-C AMPLIFIER

PT. NO. 6618760-□

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The Electronic Amplifier, Pt. Nos. 6618760-1, -2, or -3, is used with several classes of Electrical Receivers in the Type WM Recorder or Indicator. It consists of a d-c power supply, a voltage amplifier, and a motor control circuit. The voltage amplifier detects and amplifies voltage produced by unbalance in the measuring circuit. The amplified output is applied to the motor control circuit, which causes a reversing motor to run in the required direction to reposition a slidewire or the core of a movable core transformer, to rebalance the measuring circuit.

CROSS REFERENCES

Instrument or Equipment	Instruction Section
Type KM55 or WM55 Recorder and KM53 or WM53 Indicator	E12-3
Electric Receiver for Type WM55 Recorder and Type WM53 Indicator (Assembly and Components)	E12-42

BAILEY METER COMPANY • WICKLIFFE, OHIO 44092

FORM IE12-44-567

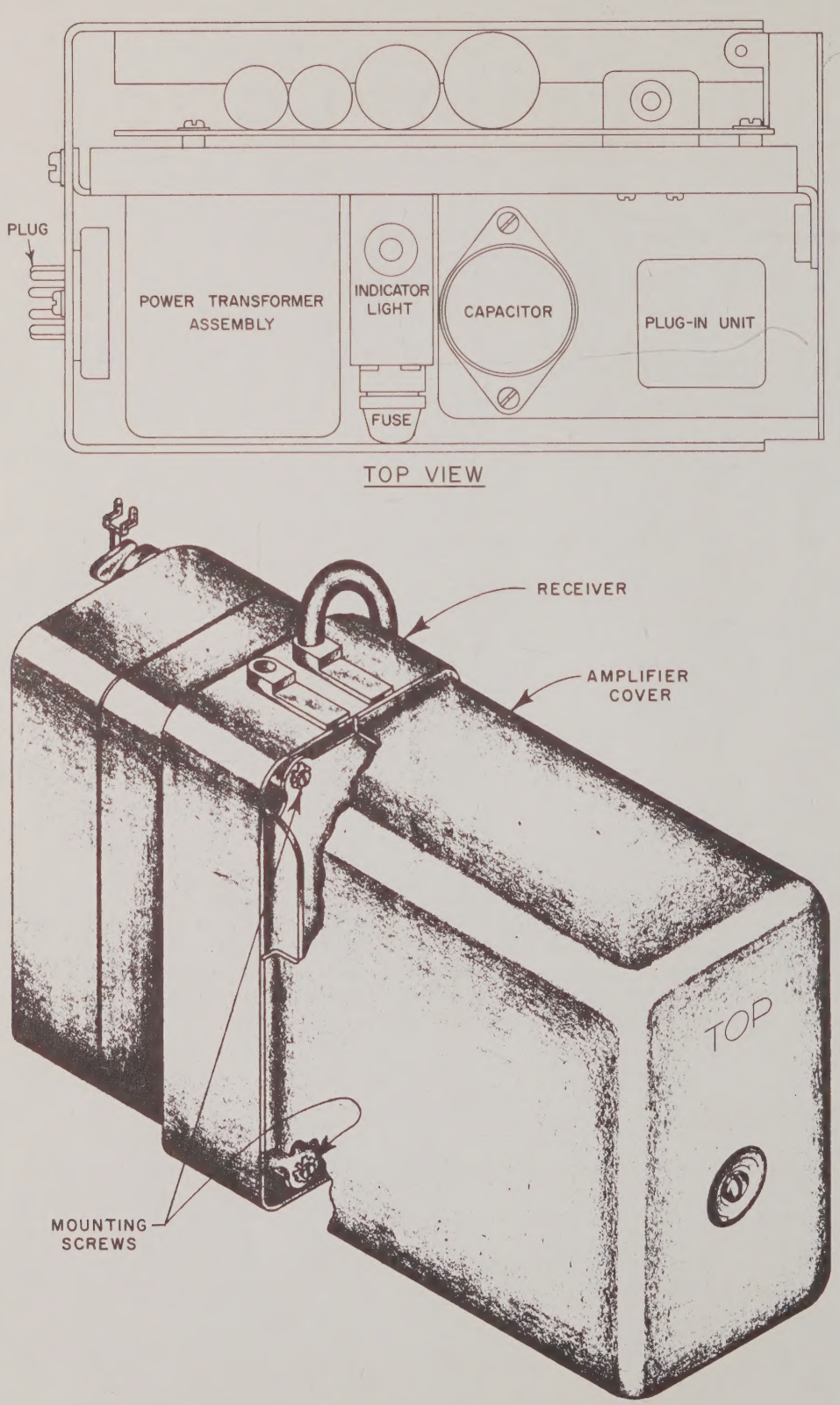

FIGURE 1 - General Assembly

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MOUNTING

The Amplifier occupies the rear section of the Electrical Receiver. Removal of the rear cover from the Receiver makes the Amplifier accessible for sensitivity adjustment, inspection, or repair.

The Amplifier assembly is plugged into a standard tube socket in the Receiver wiring board, and is secured to the Receiver case with four captive mounting screws, as shown in Figure 1.

CIRCUIT DESCRIPTION

The Amplifier consists of a plug-in unit (either a connecting plug, isolating transformer, or preamplifier), d-c power supply, two stage voltage amplifier, and a motor control circuit. The block diagram, Figure 2, shows the interrelationship of these components.

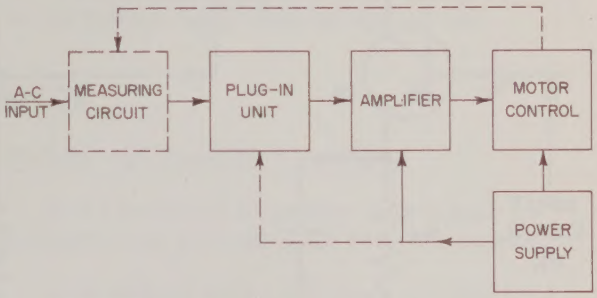


FIGURE 2 - Block Diagram of Amplifier

D-C Power Supply

D-C power is obtained from a full-wave rectified supply by means of diodes CR3 and CR4, filtered thru a capacitor-resistance filter to provide smooth d-c voltage. A schematic wiring diagram of the d-c power supply is shown in Figure 3.

Voltage Amplifier

The amplifier consists of two stages of resistance coupled amplification. Two transistors, biased for Class A operation in a common emitter configuration, are employed.

Figure 4 is a schematic wiring diagram of the amplifier. At balance condition, when the input emf equals the balance back voltage of the measuring circuit, the amplifier input voltage, e_b, is zero. Under this condition, the first stage transistor, Q1, passes a steady d-c collector current which is determined by the characteristics of the transistor and by the values of d-c voltage and collector resistors.

A change in the measured variable produces an a-c input to the amplifier. This input is applied to the base of the first stage transistor. Since this voltage is alternately positive and negative, it causes corresponding variations in the collector current. These variations in collector current cause an a-c voltage drop to be superimposed on the existing d-c voltage drop thru resistor R3 in the collector circuit.

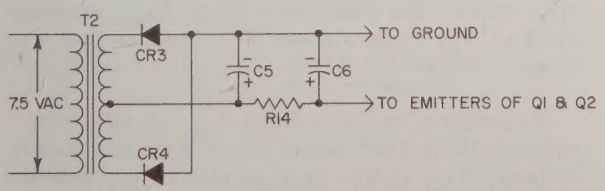


FIGURE 3 - Schematic of D-C Power Supply

Blocking capacitor C1 passes only the a-c component of the collector voltage. This voltage is applied across the sensitivity adjustment potentiometer (gain adjustment), R5. The potentiometer setting determines the portion of the voltage drop across R5 that is applied to the base of the driver stage transistor, Q2.

The output voltage of the amplifier circuit driver stage is coupled to the power stage of the motor control circuit by means of driver transformer T1 which is designed to match the impedance of the amplifier circuit.

Motor Control Circuit

The motor control circuit, shown schematically in Figure 5, controls the speed and direction of rotation of the reversing motor. The motor control transistors, Q3 and Q4, are connected in a push-pull configuration to control the power to the center-tapped control winding of the motor (E_{M1} A and B).

The motor control circuit power supply is an unfiltered d-c voltage obtained from transformer T2 thru diodes CR1 and CR2. Resistors R13 and R10 establish the operating point of the transistors.

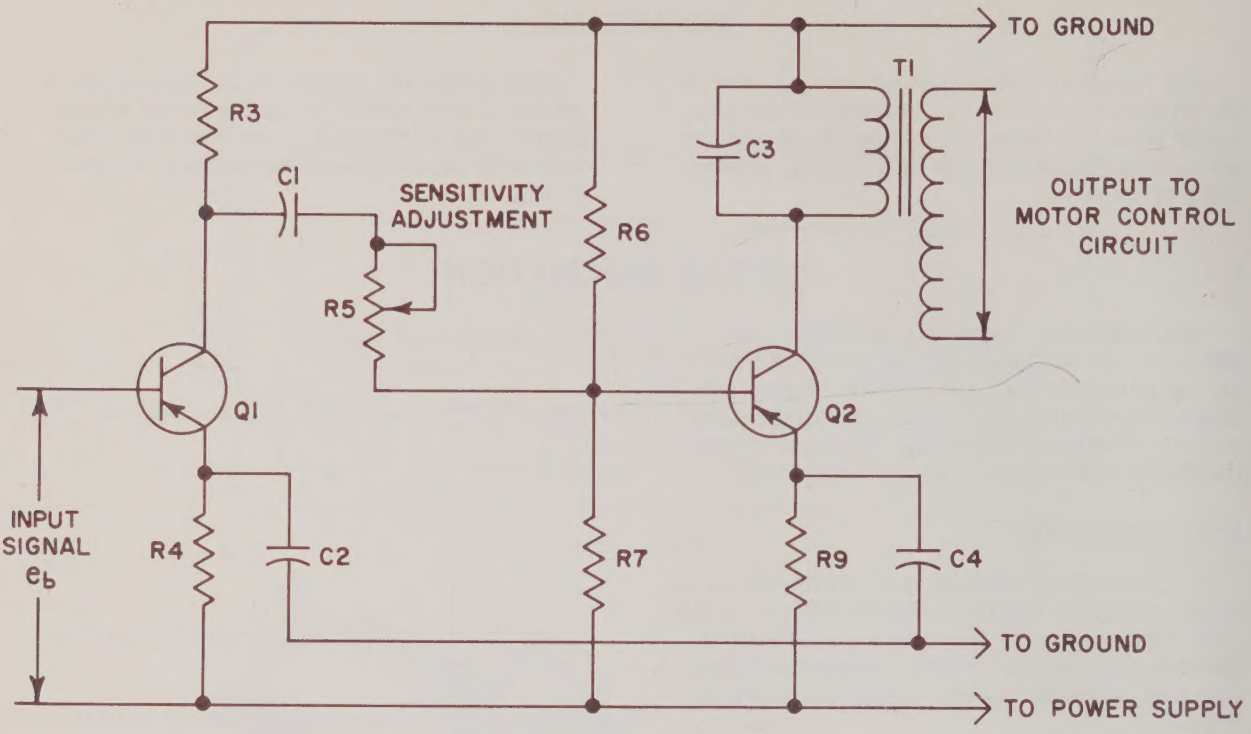


FIGURE 4 - Schematic Diagram of Voltage Amplifier

When the measuring circuit is balanced, the a-c base voltage, e_b, is zero and collector current, i_c, thru the motor control transistors is full-wave rectified a-c. (See curve in Figure 5.) When the measuring circuit is unbalanced (on an increase or decrease in the measured variable), the 60 cycle base voltage, e_b, modifies the current thru the motor control transistors by cutting off collector current, i_c, during the half-cycles when it is out of phase with the collector voltage.

NOTE: Figure 5 gives the voltage curves for a change in the measured variable.

They are 180^o out of phase. The half-cycle of the collector current that is cut off depends on the phase of voltage e_b, which in turn, depends on the direction of unbalance of the measuring circuit.

The change in collector current of the transistors also depends on the magnitude of amplifier output voltage. Thus, when base voltage e_b is relatively small,it will decrease every other half-cycle of the collector current, rather than cut it out completely. In either case, current i_c is composed of a large 60 cycle component, together with d-c and higher frequency components.

Capacitors C7 and C8 are in parallel with the motor control winding. The parallel circuit is tuned so that the capacitors are in resonance with the winding inductance for 60 cycles. This produces a large d-c voltage E_{M1} of 60 cycle frequency across the motor control winding, and reduces the harmonic voltages to a minimum since the parallel resonant circuit acts as a low impedance to harmonics. Depending on the phase of the Amplifier voltage output, as explained above, the phase of voltage E_{M1} across motor control winding W_c is either in phase with or 180^o out of phase with the supply voltage. The magnitude of E_{M1} will depend upon the amount of unbalance of the measuring circuit.

Reference winding W_p is supplied with current thru a phase shifting capacitor, C9, directly from the a-c supply voltage. This capacitor causes the phase of voltage E_{M2}, across winding W_p, to be almost 90^o ahead of the supply voltage.

Therefore, since voltage E_{M1} is either in phase with or 180^o out of phase with the supply voltage, E_{M2} either lags or leads E_{M1} and the motor runs as a two phase motor in the direction required to rebalance the circuit.

Input Plug-in Circuits

In Figure 6, note the eight-hole socket provided for a connecting plug, transformer, or preamplifier and transformer; also note the respective schematics. The type of assembly required depends on the part number of the Amplifier.

Sensitivity Adjustment

The Amplifier is furnished with an indicating light located above the motor test jacks as shown in Figure 1. The light is lit when the 60 cycle component of the voltage across the motor control winding is large enough to operate the motor.

With the Receiver measuring a steady variable, turn the sensitivity adjustment shaft clockwise until the indicating light lights and the motor oscillates continuously. Then turn the shaft counterclockwise until the oscillation stops and the light remains dim or out.

MAINTENANCE

Dusty and Damp Locations

Avoid damp or dusty locations, since the accumulation of dirt and moisture on the wiring, connections, and parts, may cause excessive electrical leakage and eventual breakdown.

Voltage and Frequency Variation

The Electronic Amplifier is designed to operate from a 118 volt 50/60 cycle supply.

Line voltage variations from 107 volts to

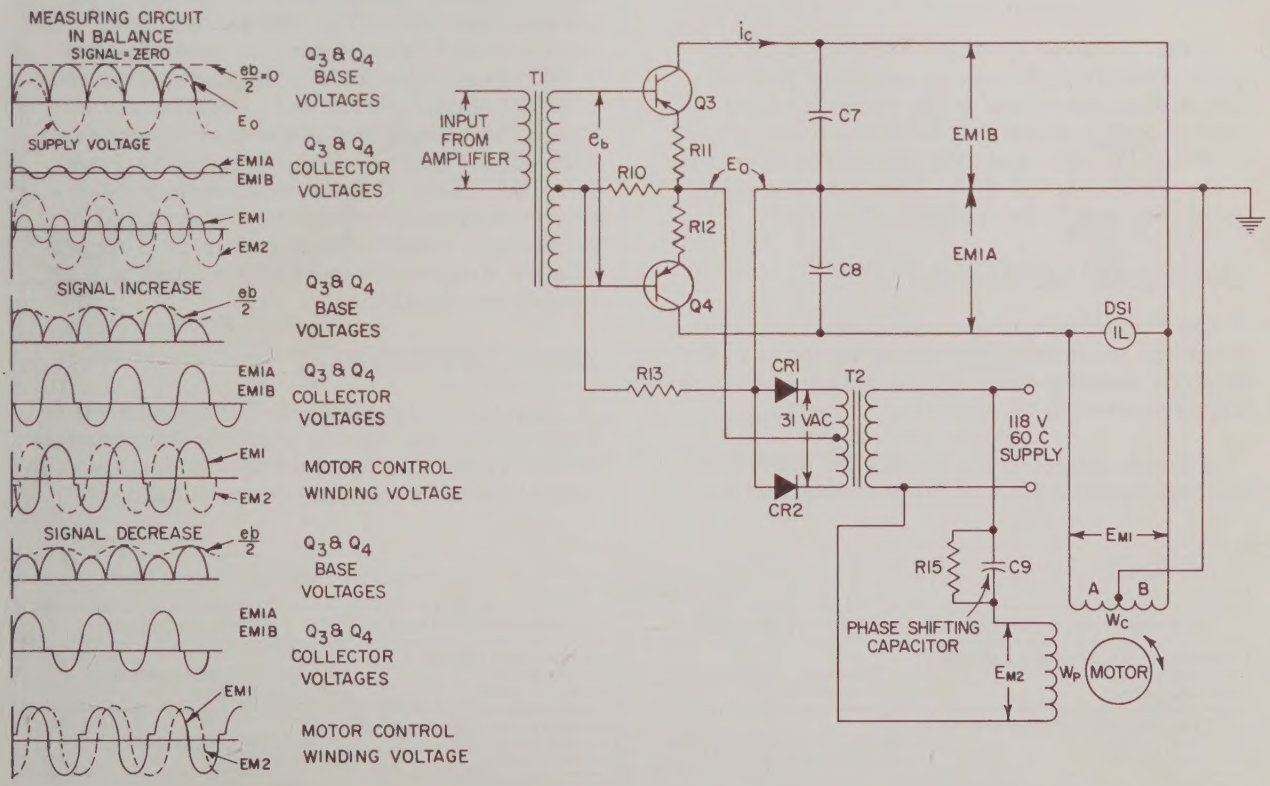


FIGURE 5 - Schematic Diagram of Motor Control Circuit

127 volts and frequency variations from 58 to 62 cycles per second will have no serious effects on accuracy and sensitivity.

Line voltage below 107 volts will result in loss of sensitivity and may cause sluggish operation of the reversing motor.

Line voltage above 127 volts may cause excessive heating in the Amplifier and in the reversing motor, particularly when the unit is subjected to high ambient temperatures.

Test for Faults

The cause of defective operation or failure to operate should be traced definitely to the Amplifier before any detailed check of this unit is attempted. The simplest way to do this is to replace the defective Amplifier with a spare. If a spare is not carried in stock, it may be borrowed from another Receiver. (Be sure that both Amplifiers bear the same part number.) If no spare is available, refer to the trouble shooting chart for the class of Receiver being tested.

If the Receiver operates properly with the spare Amplifier, it may be assumed that the first unit is defective. If the Receiver fails to operate with a spare that is known to be in good condition, it indicates that the source of trouble is elsewhere, and that the Receiver and external wiring should be checked.

Inspection and Operational Checks

Check the 1-amp fuse next to the test jacks. Check the transistors by replacing those in the defective Amplifier one by one with transistors that are known to be operating properly.

If these checks do not reveal the source of trouble, remove the unit from the back of the Receiver case and remove the base plate. Check for shorts between prongs of the transistor sockets, broken connections to these sockets, broken wires, etc.

Excessive heating of the power supply transformer, as indicated by melting of the encapsulating compound, may mean a defective transformer, a short or ground in the wiring, or a shorted filter capacitor.

Unless the source of trouble indicated by these symptoms is in the external wiring or in the transistor socket connections and can be repaired easily, the entire unit should be returned to the factory.

Circuit Checks

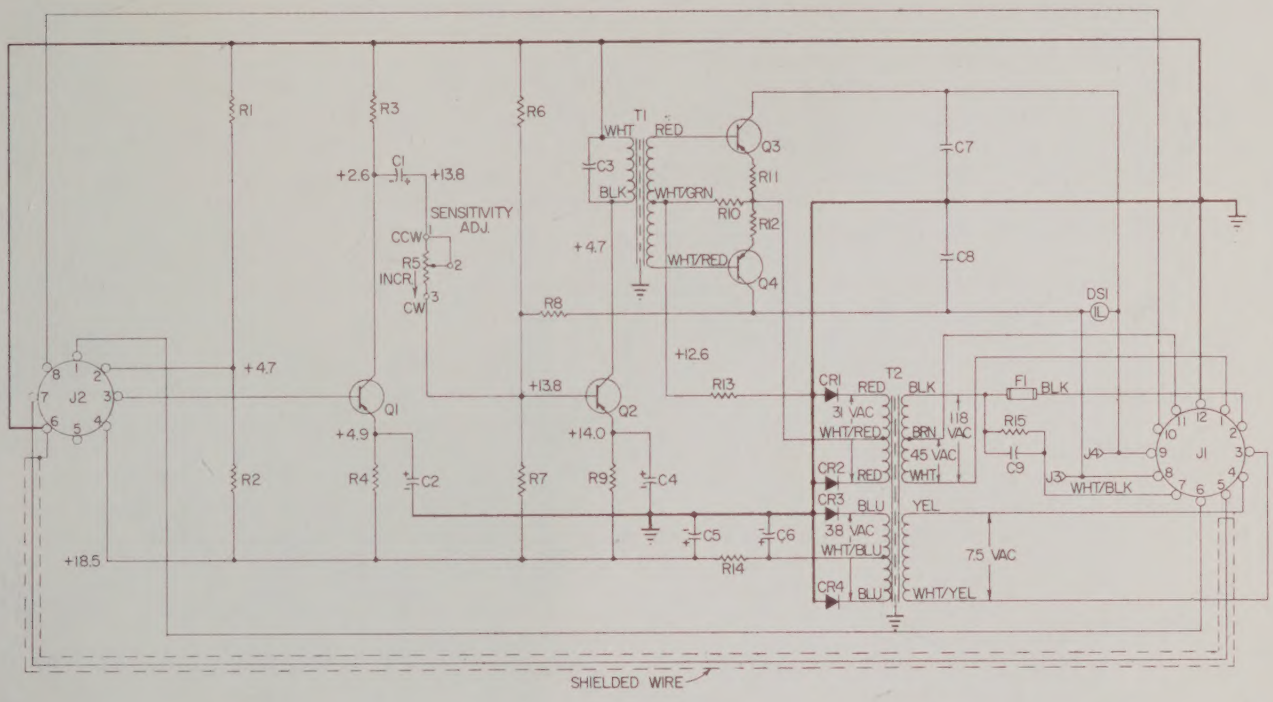
Circuit voltage checks which should locate any trouble in the Amplifier are given in Figure 6. A volt-ohm-meter and a 12-wire cable having suitable plugs at each end are required. The cable permits operation of the Amplifier when removed from the Receiver. The test meter should be a multirange type, suitable for measuring both a-c and d-c. The meter should have an internal resistance of 5,000 ohms/volts for a-c measurements and 100,000 ohms/volt for d-c measurements. Check the voltage and resistance values as indicated in Figure 6. Refer also to the Fault Location Chart. If these tests indicate a defective Amplifier that cannot be repaired by replacing a component or repairing a connection the Amplifier should be returned to the factory for repair.

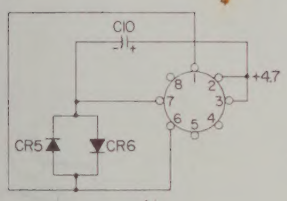
Routine Maintenance

Avoid operating the unit in locations with temperatures in excess of 120F. Operation at higher ambient temperatures will damage the insulation and eventually cause breakdown.

FAULT LOCATION CHART

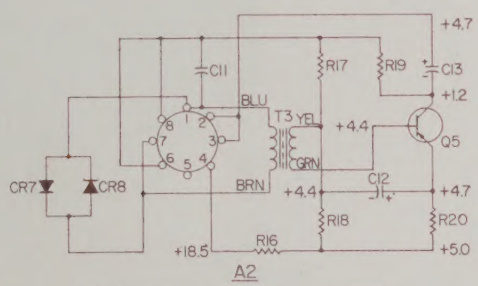
MEASURING POINT TO GROUND	PROBABLE FAULT	MEASURING POINT TO GROUND	PROBABLE FAULT
JUNCTION OF EMITTER OF Q2 AND R9. VOLTAGE IS LOW. VOLTAGE IS HIGH.	C1, C3 SHORTED. Q2 DEFECTIVE. Q1, Q2 DEFECTIVE.	JUNCTION OF C1 AND R5. VOLTAGE IS LOW. VOLTAGE IS HIGH.	Q3 SHORTED. Q2 DEFECTIVE. Q1, Q2 DEFECTIVE.
JUNCTION OF Q2 COLLECTOR AND T1. VOLTAGE IS LOW. VOLTAGE IS HIGH.	C3 SHORTED. Q1, Q2 DEFECTIVE. C1 SHORTED. Q2 DEFECTIVE.	JUNCTION OF PIN 4 OF J2 AND R2. VOLTAGE IS LOW. VOLTAGE IS HIGH.	C3 SHORTED. Q2 DEFECTIVE. Q1, Q2 DEFECTIVE.
JUNCTION OF C1 AND Q1 COLLECTOR. VOLTAGE IS LOW. VOLTAGE IS HIGH.	C2, C3 SHORTED. Q1, Q2 DEFECTIVE. C1 SHORTED. Q1, Q2 DEFECTIVE.	JUNCTION OF R1 AND R2. VOLTAGE IS LOW.	C3 SHORTED. Q1 DEFECTIVE.
JUNCTION OF R4 AND Q1 EMITTER. VOLTAGE IS LOW. VOLTAGE IS HIGH.	C2, C4 SHORTED. Q1, Q2 DEFECTIVE. Q2 DEFECTIVE	ALL POINTS. VOLTAGE IS LOW.	C5, C6 SHORTED. CR3, CR4 DEFECTIVE. T2 DEFECTIVE.





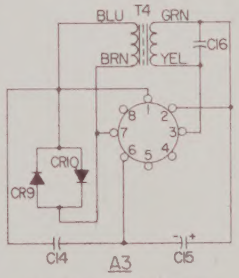
A1

CONNECTING PLUG ASSEMBLY
PT. NO. 661876IA1 USED WITH
AMPLIFIER PT. NO. 661876OA1



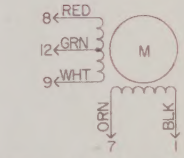
A2

PREAMPLIFIER AND ISOLATING TRANSFORMER
PT. NO. 6613404A1 USED WITH
AMPLIFIER PT. NO. 661876OA2



A3

ISOLATING TRANSFORMER
PT. NO. 6613401A1 USED WITH
AMPLIFIER PT. NO. 661876OA3



180-220 VAC HOLTZER CABOT
230-280 VAC BODINE

— HEAVY LINE INDICATES GND.

NOTES:

DC VOLTAGES (POLARITY MARKED) ARE WITH RESPECT TO GROUND.
AC VOLTAGE MEASUREMENTS MADE ON SCALE HAVING 5000 OHMS/VOLT RESISTANCE.
DC VOLTAGE MEASUREMENTS MADE ON SCALE HAVING 100,000 OHMS/VOLT RESISTANCE.

C1 . . . . . CAPACITOR 30 MFD 15V	R4 . . . . . RESISTOR 7.5K 1/2W 5%	CR7, CR8 . . . . . DIODE IN3253
C2 . . . . . CAPACITOR 2000 MFD 6V	R5 . . . . . POTENTIOMETER 250K	Q1, Q2. . . . . TRANSISTOR 2N466
C3 . . . . . CAPACITOR .1 MFD 50V	R7 . . . . . RESISTOR 3.3K 1/2W 5%	Q3, Q4. . . . . TRANSISTOR 2N376A
C4 . . . . . CAPACITOR 500 MFD 15V	R8 . . . . . RESISTOR 620K 1/2W 5%	Q5 . . . . . TRANSISTOR 2N1185
C5, C6. . . . . CAPACITOR 500 MFD 25V	R9 . . . . . RESISTOR 2.4K 1/2W 5%	T1-4. . . . . TRANSFORMER
C7, C8. . . . . CAPACITOR 25 MFD 50V	R10 . . . . . RESISTOR 2.7 OHMS 1/2W 5%	F1 . . . . . FUSE 1 AMP
C9 . . . . . CAPACITOR .6 MFD 330V	R11, R12 . . . . . RESISTOR 4 OHMS 3W 1%	J1 . . . . . AMPLIFIER PLUG
C10, C13 . . . . . CAPACITOR 100 MFD 6V	R13 . . . . . RESISTOR 220 OHMS 1W 5%	J2 . . . . . 8 PIN SOCKET
C11 . . . . . CAPACITOR .01 MFD 200V	R14 . . . . . RESISTOR 1K 1/2W 5%	J3, J4 . . . . . TEST JACK
C12, C15 . . . . . CAPACITOR 500 MFD 6V	R15 . . . . . RESISTOR 100K 1/2W 5%	DS1 . . . . . INDICATOR LIGHT
C14 . . . . . CAPACITOR .0047 MFD 200V	R16 . . . . . RESISTOR 5.6K 1/2W 5%	A1, A2, A3 . . . . . PLUG-IN UNIT
C16 . . . . . CAPACITOR 3.4 MFD 10V	R17 . . . . . RESISTOR 27K 1/2W 5%	
R1, R6. . . . . RESISTOR 10K 1/2W 5%	R18 . . . . . RESISTOR 9.1K 1/2W 5%	
R2 . . . . . RESISTOR 30K 1/2W 5%	R19, R20 . . . . . RESISTOR 620 OHMS 1/2W 5%	
R3 . . . . . RESISTOR 1.5K 1/2W 5%	CR1-6, CR9, CR10 . DIODE IN3193	

FIGURE 6 - Schematic Diagram of Complete Amplifier

REPLACEMENT PARTS

The basic Amplifier unit (without a connecting plug, plug-in transformer, or preamplifier) is identical for any of the three variations (-1, -2, -3). Thus, if two or all three variations of this Amplifier unit are in use, one complete Amplifier (-1, -2, or -3), together with the plugs for other Amplifiers in use, would permit assembly of a suitable spare for any No. 6618760 Amplifier in the system.

Other spare parts recommended for stocking for these units are included in the Instruction Sections covering the specific classes of Electrical Receivers in the Type WM55 Recorder or WM53 Indicator.

Figure 7 is a Parts Drawing for the Electronic Amplifier, Parts Nos. 6618760-1, -2, and -3. This drawing normally will apply to an Amplifier bearing one of these part numbers. However, there may be individual differences in specific units because of:

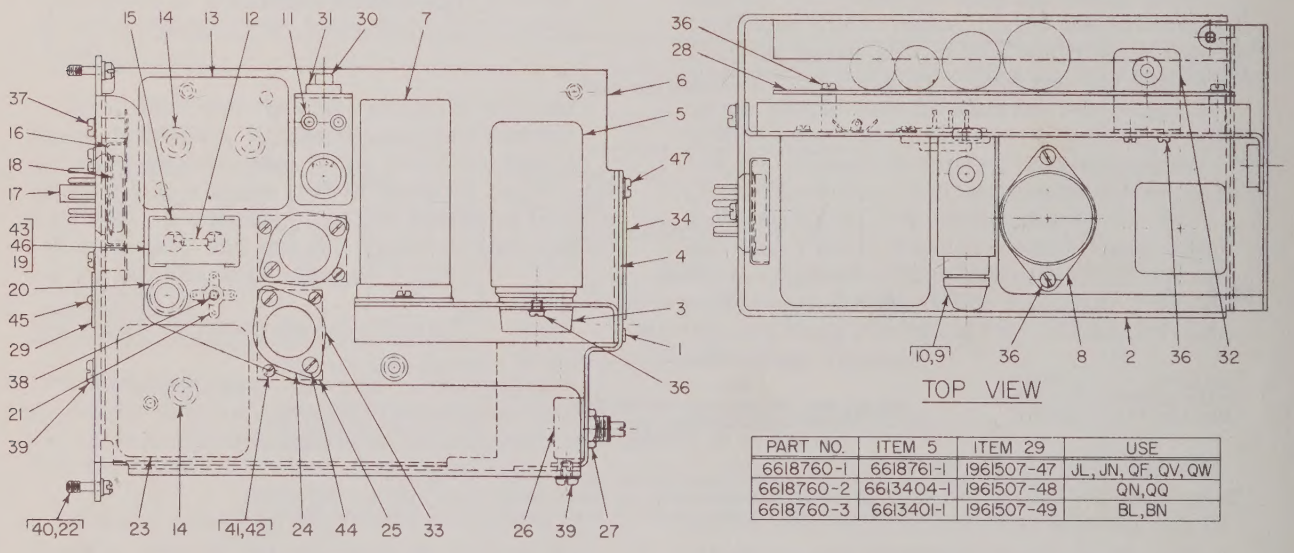
a. Design changes made since the printing of this Instruction Section.

b. Special design of the unit furnished, to make it suitable for a special application.

Therefore, when ordering parts, assure correct replacements for the Amplifier by specifying on the order:

1. Amplifier Part Number and Code Label Number (Item 1, Figure 7), and the Class of Electrical Receiver in which it is mounted.

2. The Parts Drawing on which each part is illustrated. (The Parts Drawing Number is given in the title for the Figure.)



PART NO.	ITEM 5	ITEM 29	USE
6618760-1	6618761-1	1961507-47	JL, JN, QF, QV, QW
6618760-2	6613404-1	1961507-48	QN, QQ
6618760-3	6613401-1	1961507-49	BL, BN

ITEM	PART NO.	NAME
1	1961056-1	CODE LABEL
2	6618759-1	FRAME ASSEMBLY
3	194921-4	SOCKET
4	6818755-1	END PLATE
5	SEE TABLE	PLUG-IN AMPLIFIER
6	6618752-1	CHASSIS ASSEMBLY
7	1943209-1	CAPACITOR
8	69026-1	MOUNTING RING
9	1941504-1	FUSE EXTERNAL POST
10	194776-11001	FUSE, 1 AMPERE
11	1942826-1	TEST JACK, 2 REQD
12	194841-24	RESISTOR
13	6618704-1	PWR TRANS. ASSEMBLY
14	67125-3	GROMMET, 5 REQD
15	1941160-2	PYRANOL CAPACITOR
16	667182-1	PLUG MOUNTING CUP ASSEMBLY
17	194963-4	PLUG
18	194965-1	RETAINING RING
19	6610432-1	BRACKET
20	67125-2	GROMMET
21	6612573-1	GROUND TERMINAL, 2 REQD
22	666719-1	MOUNTING SCREW, 4 REQD
23	6618703-1	DRIVER TRANS. ASSEMBLY
24	1943206-1	TRANSISTOR, 2 REQD
25	1943177-1	TRANS. SOCKET, 2 REQD
26	1942153-2	POTENTIOMETER
27	197249-1	WASHER LOCKNUT
28	6618713-1	COMPONENT BD. ASSEMBLY
29	SEE TABLE	NAMEPLATE
30	1944297-1	LAMP
31	1944298-1	SOCKET
32	6618746-1	MOUNTING BRACKET
33	1943290-1	INSULATING WASHER, 2 REQD
34	1961072-1	INSTRUCTION LABEL
36	4-40x3/16	PAN HD EXT SEMS, 14 REQD
37	6-32x3/8	PAN HD SCREW, 2 REQD
38	3-48x3/16	PAN HEAD SCREW
39	10-32x1/4	PAN HEAD SCREW, 4 REQD
40	1108	SHKPF LOCKWASHER, 4 REQD
41	4-40x1/4	PAN HEAD SCREW, 4 REQD
42	4-40	HEX NUT, 4 REQD
43	1106-00	SHKPF LOCKWASHER, 2 REQD
44	6-32x3/8	P-K TYPE Z SCREW, 4 REQD
45	0	TYPE U P-K DR SCREW, 2 REQD
46	6-32	HEX NUT, 2 REQD
47	6-32x3/16	PAN HEAD EXT SEMS, 4 REQD

FIGURE 7 - Parts Drawing E12-67, Amplifier Pt. No. 6618760-□